

# Environmental correlates of undernutrition among children of 3–6 years of age, Rajkot, Gujarat, India

Zalak Rameshbhai Matariya<sup>1</sup>, Kaushik Kishorbhai Lodhiya<sup>2</sup>,  
Rajkumar G. Mahajan<sup>1</sup>

<sup>1</sup>Department of Community Medicine, PDU Government Medical College, Rajkot, <sup>2</sup>Department of Community Medicine, GMERS Medical College, Junagadh, Gujarat, India

## ABSTRACT

**Introduction:** There are lots of studies focusing on the role of reproductive and child health factors and dietary factors on the nutrition status of the child. The present study is an attempt to highlight the role of macro- and micro-environmental factors in predicting the occurrence of undernutrition in children. **Methods:** This was a cross-sectional study conducted in field practice area of Community Medicine Department, PDU Medical College, Rajkot. The nutrition status of children was assessed using the weight for age WHO reference standards, 2006. Children below two standard deviation of the reference median (weight for age) were considered as malnourished. Data were collected for sociodemographic factors, sanitation, hygiene, and attitude of mother toward her child, etc., Data were entered in MS excel, and logistic regression was used. **Results:** Analysis of 495 selected children showed 24% prevalence of undernutrition. Employment status of mothers (adjusted odds ratio [AOR] 1.65), drinking water quality (AOR 1.53), and cleanliness of mother's hands and clothes (AOR 1.91) significantly affected the nutrition status of the child. Children classified in fair or poor category for Briscoe's sanitation scale had 1.34 and 1.92 times higher odds of being undernourished ( $P > 0.05$ ), respectively. Children classified in fair or poor category for Elizabeth's microenvironment scale had 2.05 and 2.41 times higher odds of being undernourished ( $P < 0.05$ ), respectively. **Conclusions:** Water, sanitation, and hygiene-related factors, as well as microenvironmental factors, significantly affected the nutrition status of the children.

**Keywords:** Environment, hygiene, sanitation, undernutrition

## Introduction

Undernutrition is a global public health problem considered to be a principal cause of ill-health and premature morbidities. In the year 2012, globally a total of 162 million and 99 million children aged <5 years were stunted and underweight, respectively.<sup>[1]</sup> Malnutrition is responsible for 60% of the 10.9 million deaths occurring annually directly or indirectly, among children under five globally.<sup>[2]</sup> In India, as per the National Family Health Survey (NFHS-3) report, 43% of children below 5 years of age were underweight and 15.8% were severely underweight.<sup>[3]</sup>

Undernutrition can affect many aspects of children's development such as retarding physical and mental development.<sup>[4]</sup> Undernutrition manifests itself in different forms in children such as wasting or stunting or underweight.<sup>[5]</sup>

Various socioeconomic and sociodemographic variables such as sex, age, birth order, mother's education, and mother's occupation are the background factors for child's undernutrition.<sup>[1]</sup> All these factors affect the feeding practices, sanitation, and health seeking behavior, which have direct bearing with the nutrition of the child.<sup>[6]</sup>

The immediate determinants of children's nutritional status are dietary intake and health status. These are in turn influenced

**Address for correspondence:** Dr. Zalak Rameshbhai Matariya, Department of Community Medicine, PDU Government Medical College, Rajkot, Gujarat, India.  
E-mail: matariyazalak@gmail.com

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by underlying determinants: Food security, adequate care for mothers and children, and a proper healthy environment, which includes the availability of safe water, sanitation, healthcare, and environmental safety.<sup>[7]</sup> According to the UNICEF, unhealthy household environment is one of three most common underlying factors which cause childhood malnutrition.<sup>[8]</sup>

Environmental factors in addition to maternal health, demographic, and economic factors also have a significant effect on growth and well-being of the child<sup>[9]</sup> suggesting the importance other factors on nutritional status of children but very few depicting the role of environmental factors. The present study, a rare of its kind, is an attempt to exclusively highlight the importance of macro- and micro-environmental factors on the nutritional status of the child.

## Subjects and Methods

### Study design and study area

This was community based cross-sectional study conducted by Community Medicine Department, PDU Government Medical College, Rajkot, from August to December 2015. The study was conducted in field practice area of Community Medicine Department, namely primary health center (PHC) area, community health center (CHC) area, and urban health center (UHC) areas.

### Sample size and selection of the participants

As per NFHS-3, the prevalence of undernutrition among children in Gujarat was 45%.<sup>[3]</sup> Using 95% confidence levels and 10% allowable error, the calculated sample size was 488. Hence, a total of 165 children from each of the study areas were selected for study purpose. Five anganwadi centers were selected randomly from each of the three study areas. A maximum of 33 children of 3–6 years of age were selected from each of these anganwadi centers.

### Data collection

The selected children were visited house-to-house, and informed consent from their mothers or concerned family members was obtained. The information regarding sociodemographic and environmental factors influencing the health of the child was collected using a predesigned, pretested, and semi-structured questionnaire.

### Tools used in the study

The socioeconomic status of the children was assessed using the Kuppuswamy's socioeconomic scale. The nutrition status

of the child was classified as follows. The weight of each child was compared with the WHO child growth standards 2006,<sup>[10]</sup> reference data for that particular age and sex to get weight for age indices. Children below two standard deviation of the reference median (weight for age < -2 standard deviation) were considered as malnourished and termed as underweight.

Macroenvironmental factors were assessed using Briscoe's scale for sanitation (1978).<sup>[11]</sup> The sanitation status of the houses was classified as good (score 18–21), fair (score 13–17), and poor (score 7–12).

Microenvironmental factors were assessed using Elizabeth scale (1994).<sup>[11]</sup> The caring status of the child was classified as good (score 19–24), fair (score 15–18), and poor (score 8–14).

### Statistical analysis

All data were entered in MS office excel. The trial version of the SPSS 19 IBM Corp., Armonk, New York was used to analyze the data. Appropriate tests such as Chi-square test and *t*-test were used. Adjusted odds ratio (AOR) was used to check the strength of association.  $P < 0.05$  was considered as statistically significant.

## Results

### Background characteristic

The age- and sex-specific distribution and prevalence of undernutrition among the children is depicted in Table 1. The proportion of malnutrition was highest in PHC area (29.1%) followed by CHC area (23.0%) and lowest in UHC area (18.2%). Most (55.35%) of the children were from 3 to 4 years of age group. The mean age of the children was  $3.98 \pm 0.71$  years. Age-specific mean weight was similar in both the sexes ( $P > 0.05$ ), but the overall mean weight in boys was more ( $P = 0.02$ ). Almost similar proportion of undernutrition was present in both sexes across all age groups ( $P > 0.05$ ), except for 3–4 years age group where boys had about 2.5 times more undernutrition ( $P < 0.01$ ). The total prevalence of malnutrition in the 5–6 years of age was about two times higher (40%) than that of age groups (21%). Overall a quarter (24%) of the children surveyed were found to be undernourished with boys (28%) being significantly more affected than girls (19%) ( $P = 0.02$ ) [Table 1].

Table 2 shows the logistic regression analysis of various sociodemographic variables to the prevalence of undernutrition among children. Male children and children aged more than 5 years had 1.6 and 2.2 times significantly higher odds of being

**Table 1: Age- and sex-specific mean weight±standard deviation and prevalence of undernutrition among the children**

Age	Boys	Girls	Total (%)	Mean±SD (kg)		Sex difference ( <i>t</i> -test)	<-2 SD			$\chi^2$ ( <i>P</i> )
				Boys weight	Girls weight		Boys (%)	Girls (%)	Total (%)	
3-4	149	125	274	12.4±1.3	12.3±1.6	0.525 ( $P=0.6$ )	47 (31.54)	17 (13.6)	64 (23.35)	12.22 (0.0004)
4-5	104	75	179	13.6±1.4	13.6±1.2	-0.582 ( $P=0.561$ )	20 (19.23)	18 (24)	38 (21.22)	0.59 (0.44)
5-6	22	20	42	14.2±1.3	14.0±1.8	0.209 ( $P=0.835$ )	10 (45.45)	7 (35)	17 (40.47)	0.47 (0.49)
Total	275	220	495	13±1.5	12.9±1.5	2.31 (df=493, $P=0.021$ )	77 (28)	42 (19.09)	119 (24.04)	

SD: Standard deviation

**Table 2: Prevalence of undernutrition (<-2 standard deviation) among the children and profile of socioeconomic and sociodemographic variables**

Category	Subcategory	Normal	Undernutrition		Univariate analysis		Multivariate analysis	
			Prevalence (<-2 SD)	$\chi^2$ (P)	Crude OR (CI)	P	Adjusted OR (CI)*	P
Sex	Male	198	77	5.31	1.64 (1.07-2.52)	0.02	1.59 (1.02-2.47)	0.04
	Female**	178	42		1			
Age	<5**	351	102	6.78	1	0.009	2.20 (1.10-4.39)	0.026
	>5	25	17		2.34 (1.21-4.50)			
Birth order	<3	296	97	0.43	1.19 (0.70-2.01)	0.51	-	
	3 and above**	80	22		1			
Study area	Rural**	258	72	2.67	1	0.10	1.34 (0.83-2.14)	0.221
	Urban	118	47		1.42 (0.93-2.19)			
Mother education	Up to secondary	367	118	0.45	2.89 (0.36-23.07)	0.49	-	
	Graduate and above**	9	1		1			
Education of head of household	Up to secondary	351	118	5.01	8.40 (1.12-62.70)	0.02	4.99 (0.61-40.23)	0.13
	Graduate and above**	25	1		1			
Mothers Occupation	Homemaker	281	97	2.30	1.49 (0.88-2.50)	0.12	1.65 (0.947-2.89)	0.07
	In any occupation**	95	22		1			
Occupation of HOH	Manual worker	241	84	1.69	1.34 (0.85-2.1)	0.19	0.95 (0.57-1.58)	0.86
	Others**	135	35		1			
BPL status	Yes**	123	29	2.95	1	0.08	1.50 (0.92-2.46)	0.10
	No	253	90		1.50 (0.94-2.41)			
Socioeconomic status	Class I, II**	65	9	6.72	1	0.01	1.71 (0.73-4.02)	0.21
	Class III or more	311	110		2.55 (1.23-5.30)			
Religion	Hindu**	343	106	0.49	1	0.48	-	
	Muslim	33	13		1.27 (0.64-2.51)			
Type of family	Joint**	166	46	1.11	1	0.29	-	
	Nuclear	210	73		1.25 (0.82-1.91)			

\*95% confidence interval, \*\*Reference category, variables with  $P < 0.2$  in the univariate analysis were entered into the multivariate analysis model. OR: Odds ratio; CI: Confidence interval; SD: Standard deviation; BPL: Below poverty line

undernourished ( $P < 0.05$ ). Children whose mothers and head of households who had less than secondary levels of education had 2.8 times ( $P = 0.4$ ) and 8.4 times ( $P = 0.02$ ) higher odds of being undernourished, respectively. The risk of undernutrition was 2.55 times ( $P = 0.01$ ) greater in children belonging to lower socioeconomic strata. However, children belonging to below poverty line (BPL) families had a slightly lower risk of undernutrition ( $OR = 1.5$ ,  $P = 0.08$ ).

The odds of being undernourished were higher in the following: Children of birth order one or two ( $OR = 1.19$ ), belonging to urban areas ( $OR = 2.67$ ), unemployed mothers ( $OR = 2.3$ ), head of household employed in manual work ( $OR = 1.69$ ), Muslim religion ( $OR = 1.27$ ), or from a nuclear family ( $OR = 1.25$ ). However, these differences were not statistically significant [Table 2].

Table 3 shows the association of various sanitation-related factors to the occurrence of undernutrition among the children. Children who drank unfiltered/unhygienic water and those whose mothers' hands and clothes were insanitary had 2.2 and 1.8 times significantly higher risk of being undernourished.

Among children with ring well/pond as the source of drinking water ( $OR = 1.36$ ), infrequent hand washing by mothers before handling food ( $OR = 1.28$ ) and presence of overcrowding in the house ( $OR = 1.12$ ), the risk of occurrence of undernutrition

was higher. However, these differences were not statistically significant. Nonuse of latrine facility for defecation by children had no effect on their nutrition status ( $OR = 1.006$ ,  $P = 0.9$ ) [Table 3].

Table 4 describes the association of sanitation standards and microenvironment standards with the prevalence of undernutrition among the children. Children classified in fair or poor category for Briscoe's sanitation scale had 1.34 and 1.92 times higher odds of being undernourished as compared to children classified in good category. However, this finding was statistically insignificant. Similarly, children classified in fair or poor category for Elizabeth's microenvironment scale had 2.05 and 2.41 times higher odds of being undernourished as compared to children classified in good category. This finding was statistically highly significant.

## Discussion

Malnutrition in children is a common public health problem across the globe. It threatens the future generations of any nation. In the present study, the prevalence of undernutrition among the study population was 24%. The finding of boys being more underweight than girls is consistent with that of Chakraborty *et al.* [12] but in contradiction with other studies [Table 1]. [11,13]

In the present study, older children in preschool age group had higher odds of being undernourished. This finding is supported

**Table 3: The prevalence of undernutrition (<-2 standard deviation) among the children and profile of environmental factors**

Category	Normal	Undernutrition		Logistic regression analysis				
		Prevalence (<-2 SD)	$\chi^2$	Crude OR	P	95% CI	Adjusted OR	P
Source of drinking water								
Tube well/tap**	345	106	0.801	1	0.371	0.689-2.703	-	
Ring well/pond	31	13		1.365				
Storage of water for use								
Direct use**	58	9	4.775	1	0.029	1.069-4.648	1.53 (0.70-3.34)	0.28
Clean every 6 months and covered/ unclean and uncovered	318	110		2.229				
Defecation by children <6 years								
Latrine/disposed off**	247	78	0.001	1	0.977	0.652-1.553	-	
Open within the compound/anywhere	129	41		1.006				
Hand washing by mother before handling/cooking food								
Always**	261	76	1.281	1	0.258	0.832-1.981	-	
Occasional/no	115	43		1.284				
General appearance of mother's hands and clothes								
Clean**	258	65	7.808	1	0.005	1.192-2.769	1.91 (1.20-3.04)	0.006
Partially clean/unclean	118	54		1.816				
Overcrowding								
Present	320	103	0.153	1.127	0.696	0.619-2.049	-	
Absent**	56	16		1				

\*\*Reference category. OR: Odds ratio; CI: Confidence interval; SD: Standard deviation

**Table 4: Results of logistic regression analysis with the prevalence of undernutrition (<-2 standard deviation) among the children and sanitation scale and microenvironment scale**

Category	Normal	Undernutrition		Logistic regression analysis		
		Prevalence (<-2 SD)	$\chi^2$	Crude OR	P	95% CI
Briscoe's scale for standard of sanitation						
Good**	243	67	3.378 (0.185)	1		
Fair	116	43		1.34	0.18	0.86-2.09
Poor	17	9		1.92	0.12	0.78-4.46
Elizabeth's microenvironment scoring scale						
Good**	249	57	13.104 (0.001)	1		
Fair	98	46		2.05	0.001	1.30-3.22
Poor	29	16		2.41	0.008	1.22-4.73

\*\*Reference category. CI: Confidence interval; OR: Odds ratio; SD: Standard deviation

by the studies of Cheah *et al.*<sup>[14]</sup> and Choudhury *et al.*<sup>[15]</sup> This could be explained by the fact that more attention is devoted to younger children while as they grow older, their nutritional requirement increases. At this time, they are relatively less cared of which increases their likelihood of undernutrition.

Table 2 also highlights the importance of education in general and in particular of the girl child to reduce the problem of malnutrition. Education is expected to influence the awareness of child malnutrition and to educate them more about nutrition. This finding is agreed upon by Chaudhary *et al.*<sup>[15]</sup> The risk of undernutrition being higher in lower socioeconomic class is proved by several studies.<sup>[16,17]</sup> However, in the present study, children from BPL families had a slightly lower risk of being

underweight. This was possibly due to various government sponsored incentives to the BPL families,<sup>[18]</sup> which were not available to other families living in the same sociocultural environment but not classified under BPL status.

In the present study, children having access to hygienic drinking water had significantly lower risk of undernutrition. The history of regular hand washing by mother before handling food did not have any significant effect in reducing the risk of undernutrition in children. However, the observer findings regarding the appearance of mothers' hands and clothes had a significant relation to undernutrition in children. There are several studies that have indicated the role of water, sanitation, and hygiene facilities to undernutrition.<sup>[19,20]</sup> The above findings



highlight the importance of safe drinking water, hand washing practices, and other sanitation measures to combat the problem of malnutrition in children.

Prolonged association with insanitary conditions exposes the children to fecal bacteria and other microbes leading to the chronic inflammatory reaction in the intestinal mucosa. This leads to villous atrophy, crypt hyperplasia, increased permeability, and inflammatory cell infiltrate, which causes malabsorption of essential nutrients from small intestines. This subclinical condition called environmental enteropathy leading to malnutrition has been described by certain authors.<sup>[19,21]</sup> Open defecation practices lead to frequent exposures of children to fecal bacteria and occurrence of malnutrition thereof. However, the present study did not find any significant association to the prevalence of undernutrition and use of toilet facility. This finding is consistent with that of Tigga *et al.* and Awoyemi *et al.* [Table 3].<sup>[1,13]</sup>

Briscoe's scale is a cumulative index for assessing standards of sanitation, which takes into consideration the drinking water quality, source of water, hand washing habits of mother, defecation by children, and general appearance of mother's hands and clothes. Similarly, Elizabeth scale provides us with an idea about the overall caretaking of the child through assessment of maternal attitude toward child and role of family members and neighbors toward caring of the child.<sup>[11]</sup> The results of classification of nutritional status of children according to Briscoe's sanitation scale reflected the role of sanitation in growth and development of child. The role of microenvironmental factors in the form of loving and caring for the child significantly reflected upon the nutrition status of the child. This finding is supported by Elizabeth and Sathy *et al.*<sup>[22]</sup> The above findings further strengthen the role of nonnutritive factors in predicting the nutrition status of child [Table 4].

Since this was a cross-sectional study focusing only on environmental factors, the effect of other factors such as reproductive and child health, dietary factors, and cultural practices was not assessed. The study however did prove that several sociodemographic, macroenvironmental, and microenvironmental factors were important determinants of undernutrition in children.

## Conclusions

Undernutrition is still a major public health problem. Sociodemographic factors such as age and sex of the child and mother's employment status; environmental factors such as general cleanliness of mother's hands and clothes, as well as drinking water quality, and microenvironmental factors in the form of caring and loving of the child were the significant predictors of undernutrition in children.

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## Conflicts of interest

There are no conflicts of interest.

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